APPENDIX D

MATERIAL SAFETY DATA SHEET FOR CHLORINE

APPENDIX D: MATERIAL SAFETY DATA SHEET FOR CHLORINE*

SECTION 1: CHEMICAL PRODUCTS& COMPANY IDENTIFICATION	
Occupational Health Services, Inc. 11 West 42nd Street, 12th Floor New **York, New** York 10036 **1-800-445-MSDS** (1-800+5-6737) or 1-212-789-3535	For Emergency Source **Information Contact:** 1-615-366-2000
Substance: Chlorine	CAS **Number:** 7782-50-5 RTECS **Number:** FO21OOOOO
Trade Names/Synonyms: **Chlorine Molecular;** Chlorine Mol.; **Diatomic** Chlorine; Dichloride; Molecular Chlorine; STCC 4904120; UN 1017 **CL2;** 0HS04600	
Chemical Family: Halogen	Inorganic Gss
SECTION 2: COMPOSITION/INFORMATION OF INGREDIENTS	
Component: Chlorine	**CAS Number: 7782-50-5**
Percentage: 100.0	Other **Contaminants: None**
SECTION 3: HAZARDS IDENTIFICATION	
CERCLA Ratings **(Scale** O-3): **Health** = 3 **Fire** = **0** Reactivity=O Persistence=O **NFPA Ratings (Scale 0-4):** **Health** = 3 **Fire** = **0** Reactivity=O	
Emergency Overview: Chlorine is a **greenish-yellow gas with a strong odor. Harmful if inhaled. Causes respiratory tract, skin,** and eye burns. Container may rupture in heat or fire. May ignite combustibles. Do not breathe gas. Do not get in eyes, on skin, or on clothing. Keep away from heat and flame. Store away from combustible materials. Do not puncture container. Keep **container** tightly closed. Wash thoroughly **after** handling. Use ordy with adequate ventilation.	
Potential **Health** Effects: Short Term Exposure: May cause sores, frostbite, runny nose, sneezing, paleness, hoarseness, tearing, blurred vision, drooling, bloody spit, stomach pain, coughing, difficulty breathing, lung damage, bluish skin color, **suffocation, weakness, headache, anxiety, restlessness, dizziness, irregular heartbeat, heart failure, collapse, and shock. May also cause death.** **Long Term Exposure: May cause skin sores, acne, tooth decay, and lung effects.**	
carcinogen status:	**OSHA: N** **NTP: N** **IARC: N**

* **Adapted by** permission of Occupational Health **Services,** Inc.

SECTION 4: FIRST AID MEASURES

Inhalation: First Aid — Remove from exposure area to fresh air immediately. If breathing has stopped, give artificial respiration. Maintain airway and blood pressure and administer oxygen if available. Keep affected person warm and at rest. Treat symptomatically and supportively. Administration of oxygen should be performed by qualified personnel. Get medical attention immediate y.

Skin Contact: First Aid — Remove contaminated clothing and shoes immediately. Wash affected area with soap or mild detergent and large amounts of water until no evidence of chemical remains (at least 15-20 minutes). In case of chemical bums, cover area with sterile, dry dressing. Bandage securely, but not too tightly. Get medical attention immediately.

Eye Contact: Firat Aid – Wash eyes immediately with large amounts of water, occasionally lifting upper and lower lids, until no evidence of chemical remains (at least 15-20 minutes). Continue irrigating with normal saline until the pH has returned to normal (30-60 minutes). Cover with sterile bandages. Get medical attention immediately.

Ingestion: First Aid — Do not use gastric lavage or emesis. Dilute the acid immediately by drinking large quantities of water or milk. If vomiting persists, administer fluids repeatedly. Ingested acid must be diluted approximately 100 fold to render it harmless to tissuea. Maintain airway and treat shock (Dreisbach, handbook of poisoning, 12th cd.). Get medical attention immediately. If vomiting occurs, keep head below hips to help prevent aspiration.

Note to physician:

Antidote: No specific antidote. Treat symptomatically and supportively.

SECTION 5: FIRE FIGHTING MEASURES

Fire and Explosion Hazard: Negligible fire hazard when exposed to heat or flame.

Oxidizer: Oxidizers decompose, especially where heated, to yield oxygen or other gases which will increase the burning rate of combustible matter. Contact with easily oxidizable, organic, or other combustible materials may result in ignition, violent combustion or explosion.

Extinguishing Media: Water only, no dry chemical, carbon dioxide or halon (1990 Emergency Response Guidebook, DOT P 5800.5). For larger fires, use water spray or fog (1990 Emergency Response Guidebook, DOT P 5800.5).

Firefighting: Move container from fire area if you can do it without risk. Apply cooling water to sides of containers that are exposed to flames until well after fire is out. Stay away from enda of tanks. For massive fire in cargo area, use unmanned hose holder or monitor nozzles; if this is impossible, withdraw from area and let fire bum. For small fires, contain and let bum; if fire must be fought, water spiny or fog is recommended (1990 Emergency Response Guidebook, DOT P 5800.5, guide page 20).

Extinguish using agents suitable for type of fire. Cool containers with flooding amounts of water, apply from as far a distance as possible. Avoid breathing poisonous vapors, keep upwind. Evacuate to a radius of 2,500 feet if material is leaking.

Hazardous Combustion products: Thermal decomposition products may include toxic and corrosive fumes of chlorine,

SECTION 6: ACCIDENTAL RELEASE MEASURES

Occupational Spill: Stop leak if you can do it without risk. Keep combustibles away from spilled material. Keep unnecessary people away; isolate area and deny entry until gas has dispersed. Ventilate closed spaces before entering.

Reportable Quantity (RQ): 10 pounds

The Superfund Amendments and Reauthorization Act (SARA) Section 304 requires that a release equal to or greater than the reportable quantity for this substance be immediately reported to the local emergency planning committee and the state emergency response commission (40 CFR 355.40). If the release of this substance is reportable under CERCLA Section 103, the National Response Center must be notified immediately at (800) 424-8802 or (202) 426-2675 in the metropolitan Washington, DC, area (40 CFR 302.6).

Soil Spill: Dig a pit, pond, lagoon or holding area to contain liquid or solid material. Dike surface flow using soil, sandbags, foamed polyurethane or foamed concrete. Absorb bulk liquid with fly ash or cement powder. Add caustic soda.

Air Spill: Apply water spray to knock down and reduce vapors. Knockdown water is corrosive and toxic and should be diked for containment and later disposal.

Water Spill: Neutralize with caustic soda.

If Dissolved, at a concentration of 10 ppm or greater, apply activated carbon at ten times the amount that has been spilled.

Use mechanical dredges or lifts to extract immobilized masses of pollution and precipitates.

SECI'1ON 7: HANDLING AND STORAGE

Storage: Observe all federal, state and local regulations when storing or disposing of this substance. For assistance, contact the district director of the environmental protection agency.

Protect against physical damage. Separate from combustible, organic or easily oxidizable materials and especially isolate from acetylene, ammonia, hydrogen, hydrocarbons, ether, turpentine, and finely divided metals. Store outdoors or in a well-ventilated, detached or segregated areas of noncombustible instruction (NFPA 49, Hazardous chemicals Data, 1975).

Store away from incompatible substances.

Consult NFPA Publication 43C, Storage of Gaseous Oxidizing Materials, for storage requirements.

Threshold Planning Quantity (TPQ): The Superfund Amendments and Reauthorization Act (SARA) Section 302 requires that each facility where any extremely hazardous substance is present in a quantity equal to or greater than the TPQ established for that substance notify the state emergency response commission for the state in which it is located. Section 303 of SARA requires these facilities to participate in local emergency response planning (40 CFR 355.30).

SECTION 7: HANDLING AND STORAGE (continued)

Threshold Quantity (TQ): 1,500 pounds

The Occupational Safety and Health Administration (OSHA) process safety management (PSM) standard requires that facilities using a process that involves a chemical at or above its specified threshold quantity comply with the provisions of 29 CFR 1910.119, process Safety Management of Highly Hazardous Chemicals.

SECTION 8: EXPOSURE CONTROLS/PERSONAL PROTECTION

Exposure Limits:

Chlorine:

0.5 ppm (1.5 mg/m^3) OSHA TWA; 1 ppm (3 mg/m^3) OSHA STEL
0.5 ppm (1.5 mg/m^3) ACGIH WA: 1 ppm (3 mg/m^3) ACGIH STEL
0.5 ppm (1.5 mg/m^3) NIOSH recommended TWA;
1 ppm (3 mg/m^3) NIOSH recommended STEL
0.5 ppm (1.5 mg/m^3)DFG MAK TWA;
1 ppm (3 mg/m^3) DFG MAK 5 minute peak, Momentary Value, 8 times/shift

Measurement Method: Bubbler; Ion-Specific electrode; (OSHA # 1D101).

100 pounds SARA Section 302 Threshold Planning Quantity
10 pounds SARA section 304 Reportable Quantity
10 pounds CERCLA Section 103 Reportable Quantity
1,500 pounds OSHA Process Safety Management Threshold Quantity
Subject to SARA Section 313 Annual Toxic Chemical release reporting.

NOTE: OSHA limits adopted January 19, 1989 are subject to the decision of the 11th Circuit Court of Appeals (AFL-CIO V. OSHA) as of July 7, 1992.

Ventilation: Provide local exhaust or process enclosure ventilation to meet published exposure limits.

Eye Protection: Employee must wear splash-proof or dust-resistant safety goggles and a faceshield to prevent contact with this substance.

Emergency Wash Facilities: Where there is any possibility that an employee's eyes and/or skin may be exposed to this substance, the employer should provide an eye wash fountain and quick drench shower within the immediate work area for emergency use.

Clothing: Employee must wear appropriate protective (impervious) clothing and equipment to prevent any possibility of skin contact with this substance.

Gloves: Employee must wear appropriate protective gloves to prevent contact with this substance.

Respirator: The following respirators and maximum use concentrations are recommendations by the U.S. Department of Health and Human Services, N1OSH Pocket Guide to Chemical Hazards; N1OSH criteria documents or by the U.S. Department of Labor, 29 CFR 1910 Subpart Z.

The specific respirator selected must be based on contamination levels found in the work place, must not exceed the working limits of the respirator and be jointly approved by the National Institute for Occupational Safety and Health and The Mine Safety and Health Administration (N1OSH-MSHA).

SECTION 8: EXPOSURE CONTROLWPERSONAL PROTECTION (continued)

Chlorine:

5 ppm – Arty chemical cartridge respirator with cartridge(s) providing protection against chlorine. Any supplied-air **respirator**. Any self-contained breathing apparatus.

12.5 ppm — .4ny supplied-air respirator operated in a continuous-flow mode. Any powered, air-purifying **respirator** with cartridge(s) providing protection against chlorine.

25 ppm — Any self-contained breathing apparatus with a **full facepiece**. Any supplied-air respirator with a **full facepiece**. Any **air-purifying, full-facepiece** respirator (gas mask) with a chin-style, front- or back-mounted canister providing protection any powered, **air-purifying respirator** with a tight-fitting **facepiece**. Any cartridge(s) providing **protection** against chlorine. Any chemical cartridge **respirator** with a **full facepiece and cartridge(s)** providing protection against chlorine.

30 ppm – Any supplied-air respirator that has a **full facepiece** and **is** operated in a **pressure-demand** or other Positiv-pressure mode.

Escape — any air-purifying, **full-facepiece** respirator (gas mask) with a chin-style, front- or back-mounted canister providing protection against chlorine. Any appropriate **escape-type,** self-contained breathing apparatus.

For Firefighting and Other Immediately Dangerous to Life or Health Conditions:

Any self-contained breathing apparatus that has a **full facepiece** and is **operated** in a **pressure-demand** or other **positive-pressure** mode.

Any supplied-air **respirator** that has a **full facepiece** and is operated in an **pressure-demand** or other **positive-pressure** mode in combination with an auxiliary **self-contained** breathing apparatus **operated** in **pressure-demand** or other **positive-pressure** mode.

SECTION 9: PHYSICAL AND CHEMICAL PROPERTIES

Description: Pale greenish-yellow gas with a characteristic, **suffocating** odor.	**Molecular Weight: 70.906**
Molecular Formula: Cl_2	**Boiling Point**: **–3** l°F **(—35°C)**
Melting **Point**: **—150°F** (–101"C)	**Vapor Pressure (mm Hg)**: 5168 mm **Hg @** 21°C
Vapor Density (Air = l): 2.49	**Specific** Gravity **(water = l):** 3.214 grams/liter **@ 0°C**
Water Solubility: 1.46% @ 0°C	**Odor Threshold:** 0.01 ppm
Solvent **Solubility**: Soluble in alkalies.	

SECTION 10: STABILITY AND REACTIVITY

Reactivity: Stable under normal temperatures and pressures.

Conditions to Avoid: Avoid contact with combustible materials (wood, paper, oil, etc); contact may result in ignition or explosion. Material may be poisonous; avoid inhalation of vapors or contact with skin. Do not allow material to contaminate water sources.

Chlorine Incompatibilities:

Acetylene Explosive reaction

Alcohols: Formation of explosive alkyl hypochlorites.

Alkyl Isothiourea Salts: Formation of explosive nitrogen trichloride.

Ammonia: Explodes when heated.

Antimony: Ignition reaction

Arsenic: Spontaneous ignition.

N-Arylsulfinamides: Possible violent reaction.

Benzene: Explosive reaction catalyzed by light

Boron: Ignites on contact.

Bromine Pentafluoride: Explosive reaction.

Calcium Chlorite: Forms explosive chlorine dioxide.

Calcium Nitride: Incandescent reaction.

Carbon (activated): Ignites on contact.

Carbon disulfide: Explosive reaction in the presence of iron catalyst.

Cesium Nitride: Attacked by chlorine.

3-Chloropropyne: Possible explosion.

Chromyl Chloride + Carbon: Possible explosion.

Combustible Materials: Contact with the liquid is likely to result-in an explosion. Contact with the gas may result in ignition or an explosion.

Diborane: Explodes on contact at ambient temperatures.

Dichloromethylarsine: Possible explosion.

Diethyl Ether: Explodea.

Diethylzinc: Ignition.

Dimethylformamide: Explosion hazard.

Dimethyl Phosphoramidate: May form explosive nitrogen trichloride.

Dioxygen Difluoride: Ignition or explosive reaction.

Disilyl Oxide: Explosive reaction.

4,4' — Dithiodimorpholine: May form explosive compound.

SECTION 10: STABILITY AND Reactivity (continued)

Ethylene: Explosive reaction in the presence of light or catalysts.

Ethylene I mine: Formation of explosive -chloroethylene imine.

Ethylphosphine: Explosion on contact.

Flammable compounds: Contact with the liquid is **likely** to **result** in an explosion. Contact with the gas may result in ignition or an explosion.

Fluorine: Ignition followed by **explosion on sparking.**

Hexachlorodisilane: Ignition above 200° C with possible explosion.

Hydrazine: Ignition reaction.

Hydrocarbons: Contact with the liquid ia likely to result in an explosion. Contact with the gas may result in ignition or an explosion. Addition of a Lewis acid to **chlorine-hydrocarbon** mixtures will **result** in the release of large **volumes** of **hydrogen** chloride. I

Hydrogen: Explosive mixtures.

Hydrogen Peroxide + Potassium **Hydroxide:** Luminescent reaction.

Hydroxylamine: Spontaneous ignition.

Iodine: Violent reaction.

Iron Carbide: Incandescent reaction.

Lithium Silicide: Incandescent reaction **when** heated.

Metals and Alloys: Ignition on contact; some metals may be corroded in the presence of moisture.

Metal Acetylides: Ignition Reaction.

Metal **Hydrides:** Ignition.

Metal Oxides: Vigorous reaction and possible ignition.

Metal Phosphides: Ignition.

Nitrogen Compounds: May form explosive nitrogen **trichloride.**

Nitrogen Triiodide: Explosive reaction on contact.

Non-Metal Hydrides: Ignite on **contact.**

Oxygen: Explosion on heating.

Oxygen **Difluoride:** Explodes on warming.

Phenylmagnesium Bromide: Possible explosion.

Phosphorous: Explosive reaction on **contact** with the liquid; ignition on contact with the gas.

Phosphorous Compounds: Ignition.

Phosphorous Isocyanate: Vigorous reaction.

Polychlorobiphenyl: Exothermic Reaction.

(Poly) Oxomonosilane: Ignition.

Potassium Halides: Ignition.

SECTION 10: STABILITY AND REACTIVITY (continued)

Sin: Ignite-s on contact with gaseous chlorine at ambient temperatures.

Sines: Possible explosion on heating.

Sodium Hydroxide: Violent reaction.

Stannous Fluoride: Reaction occurs with flaming.

Stibine: Explosive reaction if heated.

Sulfamic Acid: May form explosive nitrogen **trichloride.**

Sulfides: Ignition.

Tellurium: Incandescent reaction.

Tetramethyldiirsine: Spontaneous ignition.

Tetramethylsilane: Possible explosion in presence of a catalyst.

Tetraselenium Tetranitride: Explosion on contact.

Trialkylboranes: Ignition reaction.

Trimethyl Thionophosphate: Possible explosion.

Vanadium (Powder): Explosion on contact with the liquid.

Hazardous Decomposition: Thermal decomposition products may include toxic and corrosive fumes of chlorine.

Polymerization: Hazardous polymerization has not been **reported** to occur under normal temperatures and **pressures.**

SECTION 11: TOXICOLOGY INFORMATION

Chlorine Toxicity Data: 2530 mg/m^3/30 minutes inhalation-human LC_{LO}; 500 **ppm/5** minutes **inhalation-**human LC_{LO}; 293 **ppm/1** hour inhalation-rat LC_{50}; 137 **ppm/1** hour inhalation-mouse LC_{50}; 660 **ppm/4** hours inhalation-rabbit LC_{LO}; 330 **ppm/7** hews inhalation-guinea pig LC_{LO}; **800 ppm/30** minutes inhalation-dog LC_{LO}; **660 ppm/4** hours inhalation-eat LC_{LO}; 500 **ppm/5 minutes inhalation-mammal LC_{LO}; mutagenic data (RTECS);** reproductive effects data **(RTECS).**

Carcinogen Status: None.

Local Effects: Corrosive – Inhalation, skin, eye.

Acute toxicity Level: Toxic by **inhalation.**

Target Effects: Poisoning may affect the lungs.

At Increased Risk from Exposure: Persons with pm-existing **heart** disease or tuberculosis.

SECTION 11: TOXICOLOGY INFORMATION (continued)

Health Effects:

Inhalation of Chlorine: Corrosive/Toxic

30 ppm immediately dangerous to life or health.

Acute Exposure – Mucous membrane irritation may occur at 0.2 to 16 ppm and cough at 30 ppm. Inhalation of 500 ppm for 5 minutes has been lethal in humans and 1,000 ppm may be fatal after a few deep breaths. Occupational exposures have resulted in burning of the nose and mouth with rhinorrhea, respiratory distress with coughing, choking, wheezing, mica, retching, hemoptysis, substernal pain, dyspnea, and cyanosis. Tracheobronchitis, progressing to immediate or possibly delayed pulmonary edema and occasional pneumonitis have also been reported. Cough generally increases in frequency and severity after 2 to 3 days and became productive of thick mucopurulent sputum, which disappears by the end of 14 days. Lung damage is usually not permanent; respiratory distress usually subsides within 72 hours. At high concentrations, chlorine may act as an asphyxiant by causing cramps of the larynx muscles and swelling of the mucous membranes. other symptoms may include salivation, anxiety, sneezing, pallor or redness of the face, weakness, hoarseness, headache, dizziness, and general excitement and restlessness. Massive inhalation may also cause death by cardiac arrest.

Chronic Exposure — Persons repeatedly exposed to low concentrations may develop chloracne, olfactory deficiency and tolerance build-up. prolonged and repeated exposure to 0.8- 1.0 ppm may cause permanent, although moderate reduction in pulmonary function. Chronic exposure at 5 ppm may result in inflammation of the mucous membranes of the nose, disease of the bronchi, and increased susceptibility to respiratory infection including tuberculosis. Dental erosion may occur. Animals surviving sublethal exposures for 15 to 193 days alter gassing showed marked emphysema.

Skirt **Contact:**

Chlorine: Corrosive.

Acute Exposure — High vapor concentrations may irritate the skin and cause burning and pricking sensations, inflammation, and vesicle formation. Contact with liquid may cause bums, blistering, tissue destruction, and frostbite.

Chronic Exposure – Effects depend on the concentration and duration of exposure Repeated or prolonged contact may result in dermatitis or effects similar to acute exposure.

Eye Contact:

Chlorine: Corrosive.

Acute Exposure – Exposure to concentrations of chlorine gas as low as 3-6 ppm may cause redness, pain, blurred vision, and lacrimation. Direct contact with liquid may cause bums. Chlorine dissolved in water, and placed into the anterior chambers of rabbit eyes caused severe inflammation, corneal opacity, iris atrophy and injury to the lens.

Chronic Exposure – Effects depend on the concentration and duration of exposure. Repeated or prolonged exposure may cause conjunctivitis or effects as in acute exposure.

Ingestion of Chlorine:

Acute Exposure – Ingestion of a gas is very unlikely. Ingestion of the liquid may cause bums of the lips, mouth and mucous membranes of the gastrointestinal tract, possible ulceration or perforation, abdominal pain, tachycardia, prostration and circulatory collapse.

Chronic Exposure – No data available.

SECTION 12: ECOLOGICAL INFORMATION

Environmental Impact Rating (O-3): No data available.

Acute Aquatic Toxicity: No data available.

Degradability: No data available.

Log Bioconcentration Factor (BCF): No data available.

Log Octanol/Water Partition Coefficient: No data available.

SECTION 13: DISPOSAL INFORMATION

RCRA Hazardous Waste: No data available.

Waste Disposal: Disposal must be in accordance with standards applicable to generators of hazardous waste, 40 CFR 262, EPA Hazardous Waste number DOOl. A 100-pound (CERCLA Section 103) Reportable Quantity.

SECTION 14 TRANSPORTATION INFORMATION

Department of Transportation Hazard Classification:
49 CFR 172.101, Nonflammable gas

Department of Transportation Labeling Requirements:
49 CFR 172.101 and Subpart E, Nonflammable gas and poison

Department of Transportation Packaging Requirements:
49 CFR 173.304; 49 CFR 173.314 and 49 CFR 173.315

Exceptions: None

Final ruk on hazardous materials regulations (HMR, 49 CFR Parts 171-180), Docket numbers HM-181, HM-181A, HM-181B, HM-181C, HM-181D and HM-204. Effective date October 1, 1991. However, compliance with the regulations is authorized on and after January 1, 1991. (55 FR 52402, 12/21/90).

Except for explosives, inhalation hazards, and infectious substances, the effective date for hazard communication requirements is extended to October 1, 1993. (56 FR 47158. 09/18/91).

U.S. Department of Transportation Shipping Name-ID Number:
49 CFR 172.101, Chlorine-UN 1017

U.S. Department of Transportation Hazard Class or Division:
49 CFR 172.101, 2.3- Poisonous Gas

U.S. Department of Transportation Labeling Requirements:
49 CFR 172.101 and Subpart E, Poison Gas

U.S. Department of Transportation Packaging Authorizations:

Exceptions: None

Non-Bulk Packaging: 49 CFR 173.304

Bulk Packaging: 49 CFR 173.314 and 49 CFR 173.315

SECTION 14: TRANSPORTATION INFORMATION (continued)

U.S. Department of Transportation Packaging Authorizations: 49 CFR 172.101

Passenger Aircraft or Railcar: h-bidden

Cargo Aircraft Only: Forbidden

SECTION 15: REGULATORY INFORMATION

TSCA Status: Y

Other Regulatory Information Available:

CERCLA section 103 (40 CFR 302.4):	Yes 10 pounds RQ
SARA Section 302 (40 CFR 355.30):	Yea 100 pounds TPQ
SARA Section 304 (40 CFR 355.40):	Yea 10 pounds RQ
SARA Section 313 (40 CFR 372.65):	Yes
OSHA Process Safety (29 CFR 1910.119):	Yes1,500 pounds TQ
California Proposition 65:	No

SARA Hazard Categories, SARA Sections 311/312 (40 CFR 370.21)

Acute Hazard:	Yea
Chronic Hazard:	No
Fire Hazard:	No
Reactivity Hazard:	No
Sudden Release Hazard:	Yes

SECTION 16: OTHER

Creation Date: 10/16/84 | Revision Date: 12/30/93

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